IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF OKLAHOMA

STATE OF OKLAHOMA, ex rel, W. A. DREW EDMONDSON, in his capacity as ATTORNEY GENERAL OF THE STATE OF OKLAHOMA, and OKLAHOMA SECRETARY OF THE ENVIRONMENT C. MILES TOLBERT, in his capacity as the TRUSTEE FOR NATURAL RESOURCES FOR THE STATE OF OKLAHOMA,	§	
Plaintiff,	§	CASE NO. 05-CV-329-GKF-SAJ
V.	§	
TYSON FOODS, TYSON POULTRY, INC., TYSON CHICKEN, INC., COBB-VANTRESS, INC., AVIAGEN, INC., CAL-MAINE FOODS, INC., CAL-MAINE FARMS, INC., CARGILL, INC., CARGILL TURKEY PRODUCTS, LLC, GEORGE'S, INC., GEORGE'S FARMS, INC., PETERSON FARMS, INC., SIMMONS FOODS, INC. AND WILLOWBROOK FOODS, INC.	§	
Defendants.		

AFFIDAVIT OF ,

The undersigned, Shanon J. Phillips, does solemnly swear and state:

1. I grew up in Lenexa, Kansas, one generation removed from the family farm near Emporia, Kansas. I received a B.S. degree in Biology from Kansas State University in 1990 where I focused on Pre-Veterinary medicine. I received an M.S. in Zoology from Oklahoma State University in 1995 where I

EXHIBIT
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studied Nutrient Limitation of Lake Tenkiller and participated in an EPA Clean Lakes Diagnostic and Feasibility Study of the lake aimed at studying its water quality problems and recommending solutions to those problems. In 1995 I went to work for the Oklahoma Water Resources Board in their Clean Lakes Program, finishing similar studies on lakes across the State. I came to work for the Oklahoma Conservation Commission (OCC) in 1997 where I was hired to analyze data and write reports on their projects. Since that time, I have advanced through the Water Quality Division to become the Senior Technical Writer and now the Assistant Division Director. During my tenure with OCC, I have served on various State Technical Working Groups evaluating the impacts of nutrients on water quality in the State and working towards standards and solutions to those problems. During my time at OCC I have written many reports on the Illinois River Watershed and analyzed much of the data collected by the OCC and many other agencies. I have regularly presented this data at technical meetings both within the State and across the country. I am recognized by my peers for my knowledge of the water quality issues in the Illinois River and similar watersheds.

2. I have been asked by the Oklahoma Attorney General's office to clarify that the current water quality degradation that exists in the Illinois River Watershed was documented in studies of the watershed that were completed prior to 2002. Studies dating back to the late 1970s and early 1980s show evidence of the water quality problems seen today. In addition, a significant amount of the current pollutants affecting the water quality may be attributable to events which occurred more than five years ago, but may just now be manifested in the form of water quality problems. As a result of my library research and my own work in the Illinois River Watershed, I am familiar with much of the original research that has been completed on the watershed. Through OCC projects in the watershed, I am also familiar with many of the

farming practices in the watershed, along with other activities which may affect water quality.

3. The quality of the water in a stream, river, or lake is a product of the activities that occur in its watershed. Throughout its post-settlement history, the Illinois River Watershed has been largely agricultural. Settlement in that part of the country saw clearing of many forests and conversion to cropland and orchards. As the land proved itself to be unsuitable for this kind of use and the Great Depression shook the country, farmers sought alternatives to row crops such as cotton and began to turn to poultry farming. The Army's demand for chicken during World War II helped further grow the industry in Arkansas. The industry gradually grew into Oklahoma. Poultry waste spread on nearby pastures allowed the soils which had been depleted and eroded by row-cropping to produce fertile pasture, and many poultry producers developed beef operations also.

4. Nutrients such as phosphorus and nitrogen are required by aquatic ecosystems for healthy growth. However, an excess of one or more of these nutrients can cause an imbalance in the system which often leads to water quality problems. This imbalance is generally in the form of an algae bloom which has a ripple effect on the remainder of the aquatic community. As the algae grow, they produce oxygen during photosynthesis and consume it during nighttime respiration. The result can be huge swings in the oxygen content of the water which can effectively suffocate fish, insects, and other invertebrates living in the water. Most algae have a relatively short life cycle and as they die off, bacteria populations grow to consume the dead algae. The expanding bacteria population also depletes the water of oxygen through respiration. The types of algae that favor high nutrient concentrations are also the types of algae that are more likely to cause taste and odor problems in drinking water and

some types release toxins which may affect aquatic organisms, people or other animals that drink or swim in the water.

5. Phosphorus concentrations in the Illinois River Watershed are naturally low compared to many other parts of the state because there are not many natural sources of phosphorus in the geology of the region. Therefore, elevated levels of phosphorus are due to the influx of phosphorus from outside of the watershed. These elevated phosphorus levels are considered phosphorus pollution because of the negative effects they have on water quality. Water quality pollution is generally referred to as either point-source or nonpoint source pollution. Point source pollution is something that can be traced to a single source such as a wastewater treatment plant or industrial discharge. Nonpoint source pollution occurs when rainfall, snowmelt, or irrigation runs over the land or through the ground and picks up pollutants which it carries to waterbodies. Nonpoint source pollution cannot be easily traced to a single point of origin and therefore is much more difficult to measure.

6. Due to its importance to Oklahoma, a significant amount of research has been completed by various groups, documenting the water quality of the Illinois River Watershed. From these studies, it is apparent that elevated nutrient concentrations and water quality problems in the Illinois River and Lake Tenkiller extend back at least into the 1970s. One of the earliest of these studies (*A Preliminary Study of the Water Quality of the Illinois River in Arkansas by P.D. Kittle, E. Short, and R. Rice, 1974*) was completed by the University of Arkansas with funding from private property owners along the Illinois River who were intent on estimating impacts from the proposed construction of two sewage treatment plants at Savoy and Siloam Springs, Arkansas. Although the study collected only one day's worth of data, as a baseflow sample, it should be fairly representative of average conditions and provides a window to river conditions at that time. The study collected data

from eight sites along the river in Arkansas, four above wastewater treatment plants and four below treatment plants. Sites 5 – 8 are below the confluence of Osage Creek, which receives effluent from Springdale and Rogers, Arkansas. Sites 1-4 drained mostly agricultural land would not have had much sewage effluent at that time. As seen in the table below, average ortho-phosphorus concentrations throughout the watershed are elevated above reference streams for the region (roughly equivalent to 0.037 mg/L of total phosphorus.

Physico-chemical data from the Illinois River, June 29 and 30, 1974.

Monitoring Station	Dissolved Oxygen (mg/l)	pH	Turbidity (FIU)	Chloride (mg/l)	Ammonia (mg/l)	Nitrate (mg/l)	Filterable Ortho-phosphate (mg/l)	Total Ortho-phosphate (mg/l)
IR-1	7.6	7.9	12	9.99	0.329	1.76	0.083	0.134
IR-2	9.6	8.3	10	9.99	0.486	1.84	0.085	0.996
IR-3	8.8	8.2	12	9.99	0.244	1.57	0.085	0.138
IR-4	8.5	7.5	10	9.99	0.317	1.63	0.078	0.142
IR-5	7.6	7.9	12	11.50	0.329	2.23	0.271	0.446
IR-6	8.2	8.1	14	11.00	0.289	2.19	0.267	0.460
IR-7	10.9	8.5	11	11.00	0.301	1.99	0.252	0.424
IR-8	10.3	8.4	16	10.50	0.374	1.96	0.203	0.342
Avg.	8.9	8.1	12	10.49	0.334	1.89	0.166	0.385

7. Lake Tenkiller was also documented as having water quality problems related to excess nutrients in the 1970s. The United States Environmental Protection Agency sampled lakes and reservoirs across the country as part of the National Eutrophication Survey in 1974 – 1975. Based on their survey, EPA found that Tenkiller was eutrophic (nutrient enriched) and that algal growth in the lake was limited by the availability of phosphorus. The study also evaluated sources of the phosphorus to Lake Tenkiller and found that approximately 84% of the phosphorus loading to the lake was from nonpoint source pollution. Given the landuse in the watershed at that time, this nonpoint source pollution would have largely been derived from pastureland in the watershed. Phosphorus derived from pastureland originates from animal waste spread as fertilizer or commercial fertilizer. It is stored in the soil and some may cycle through vegetation and grazing animals. It may be released to

waterbodies either from decaying vegetation, manure of grazing animals or erosion of soil particles. Given that the watershed soils were very poor in phosphorus after the period of farming pre 1930, the phosphorus contained in runoff that polluted Lake Tenkiller was derived from fertilizer applied to the pastures, either as poultry waste or commercial fertilizer.

Sources of nutrient loading to Lake Tenkiller based on monthly grab samples, 1974-1975.

Source	Location	kg P / yr	% of total	kg N / yr	% of total	Flow (m^3/sec)
NPS	Illinois River	68,875	63.2	1,750,390	67.4	23.68
	Baron Fork	8,605	7.9	434,890	16.8	8.45
	Minor tributaries	13,685	12.6	321,290	12.4	9.04
Municipal STPs	Tahlequah	8,725	8	18,015	0.7	
	Westville	1,135	1	3,400	0.1	
	Stilwell	7,110	6.5	12,995	0.5	
Misc.	Septic	20	<0.1	705	<0.1	
	Direct Precipitation	895	0.8	55,265	2.1	
Total		109,050		2,596,950		

8. A study completed by the Oklahoma State Department of Health (OSDH) (*Water Quality Survey of the Illinois River and Tenkiller Ferry Reservoir by the Oklahoma State Department of Health, 1978*) provides further evidence of the long-term impacts to the Illinois River Watershed from elevated nutrients from nonpoint source pollution. The study sampled Tenkiller Reservoir and the Illinois River upstream of the reservoir from 1975-1977 to examine point and nonpoint sources of pollution and their impact on the watershed. The primary goal of this project was to provide baseline data to determine necessary regulatory actions to abate deterioration of water quality in the basin.

OSDH water quality data. All values are in mg/L.

Site Description	Total Nitrogen	Total Phosphorus	TKN
Illinois River-above Lake Frances on Hwy 59	2.3	0.14	0.9
Illinois River-below Lake Frances at Watts	2.9	0.20	1.3
Illinois River-above confluence of Flint Creek	2.2	0.13	1.1
Illinois River-below confluence of Flint Creek	2.1	0.10	1.6
Illinois River-at Comb's Bridge	1.4	0.07	0.8
Illinois River-east of Tahlequah	0.4	0.07	0.5
Illinois River-below confluence of Tahlequah Creek	2.4	0.12	1.0
Illinois River-above confluence of Baron Fork	2.2	0.06	1.3

Illinois River-below confluence of Baron Fork	2.1	0.10	0.7

Major conclusions from this study are summarized below:

a. Lake Frances was determined to be in the late stages of eutrophication due to heavy siltation and elevated nutrient levels from the Illinois River in Arkansas. Comparative water quality directly above the headwaters and at points downstream from the Lake Frances Dam indicated high nutrient loading to the Illinois River in Arkansas.

b. Recreational activities in the lower Flint Creek drainage and in various segments of the Baron Fork and the Illinois River did not appear to contribute significant nutrient loading, but biological communities appeared to be disturbed at and below areas of high public usage.

c. Non-point sources were determined to contribute approximately 95% of the nutrient loading to the Illinois River drainage basin in Oklahoma

d. The water quality of the Illinois River was determined to improve from Lake Frances to below Baron Fork. This improvement suggests that sources of pollution, at the time, appeared to be concentrated higher in the watershed and as the river neared Lake Tenkiller, much of the pollution had settled out or been diluted. Tahlequah Creek, carrying City of Tahlequah effluent, did appear to significantly increase nutrient concentrations in the lower river, although not to the levels seen below the State line. Other than Tahlequah Creek, significant new sources of additional pollutants appeared to be lacking as one moved further into the Oklahoma portion of the watershed.

9. Studies completed by state agencies and universities in Arkansas and Oklahoma continued to document similar findings in the 1980s, but it was the EPA Clean Lakes Diagnostic Feasibility Study completed by Oklahoma State University in Cooperation with the Oklahoma Water Resources Board in 1996 that led Oklahoma and Arkansas to set the first firm goal for phosphorus reductions to the watershed. The report found the lake to be eutrophic, largely

due to nonpoint source pollution. The report recommended an interim phosphorus load reduction of 40%, but stated that load reductions of 70 – 80% would likely be necessary to meet water quality goals.

10. Water quality studies continued to document increasing water quality problems in the watershed associated with excess phosphorus into the late 1990s and early 21st century. The United States Geological Survey completed a set of studies in 2006 that document increasing phosphorus concentrations and loading to the watershed over time. These studies analyzed data from five USGS stations in Oklahoma from 1997 to 2004 in order to summarize phosphorus concentrations and estimate phosphorus loads, yields, and flow-weighted concentrations in the Illinois River basin. Phosphorus concentrations in the basin were significantly greater in runoff samples than in baseflow samples for all monitoring stations and all time periods as shown in the table below. The study cited the addition of phosphorus from nonpoint sources such as fertilized pastures as a substantial contributor to excess phosphorus in the stream. The study cited wastewater treatment plant effluent as the major contributor of point source pollution.

Phosphorus loads and concentrations in the Illinois River, 1997-2004.

Station Name	3-yr. period	Mean annual total phosphorus load (lb/yr)	Mean annual base-flow phosphorus load (lb/yr)	Mean annual runoff phosphorus load (lb/yr)	Mean flow-weighted phosphorus concentration (mg/L)
Illinois River near Watts	1997-1999	164,000	69,600	96,200	0.120
	1998-2000	329,000	73,500	256,000	0.233
	1999-2001	438,000	97,700	356,000	0.320
	2000-2001	515,000	116,000	399,000	0.409
	2001-2003	384,000	96,100	288,000	0.362
	2002-2004	366,000	63,900	302,000	0.337
Flint Creek near Kansas	1997-1999	40,200	11,900	29,500	0.186
	1998-2000	80,400	12,200	68,300	0.335
	1999-2001	87,700	12,700	73,400	0.362
	2000-2001	70,000	11,100	58,900	0.339
	2001-2003	32,300	10,200	22,000	0.211
	2002-2004	49,500	12,000	37,500	0.269
Illinois River near Chewey	1997-1999	292,000	74,300	217,000	0.185
	1998-2000	438,000	74,200	382,000	0.265
	1999-2001	548,000	79,400	465,000	0.339
	2000-2001	549,000	94,900	454,000	0.374
	2001-2003	348,000	77,300	271,000	0.287
	2002-2004	405,000	59,100	346,000	0.319
Illinois River near Tahlequah	1997-1999	307,000	68,800	238,000	0.156
	1998-2000	511,000	67,000	446,000	0.238
	1999-2001	621,000	68,600	543,000	0.289
	2000-2001	559,000	65,700	493,000	0.287
	2001-2003	331,000	60,900	271,000	0.214
	2002-2004	355,000	53,400	302,000	0.217
Baron Fork at Eldon	1997-1999	32,800	4,570	28,400	0.045
	1998-2000	124,000	4,920	120,000	0.165
	1999-2001	135,000	5,980	128,000	0.190
	2000-2001	154,000	5,660	148,000	0.239
	2001-2003	59,000	5,360	53,600	0.120
	2002-2004	120,000	5,000	115,000	0.226

The studies found that average annual loading entering Tenkiller ranged from 391,000-712,000 lb/yr, with 83-90 percent of the load being derived from runoff.

9. It is important to note that activities which occurred in previous decades may only now be impacting water quality in the river. The reason for this is that

phosphorus readily binds to soil particles where it may remain sequestered away from streams. However, heavy rainfall, road building, construction, soil tillage or other activities may dislodge these soil particles and deliver them to a stream. One example of how this might occur is through changes in landuse in the watershed. Phosphorus that was applied to soils in Arkansas in the 1970s may have become bound to soil particles, and remained largely inert in the watershed. However, as land becomes developed, that phosphorus-laden particle may now become dislodged from its original site and transported to a stream. Conditions in the stream and downstream lakes can loosen the phosphorus from the soil particle and make it available to algae. Another such example of how phosphorus deposited in the watershed years ago may only now be impacting water quality has to do with the function of riparian areas along streams. Riparian areas trap soil particles and serve as nutrient filters and sinks. Disturbances of these areas may release nutrients that were deposited during the last rainstorm or even decades previous. It is important to note that disturbance of the soil is not necessary for this "older" phosphorus to be delivered to the stream. Phosphorus attached to soil and phosphorus in the pore water of soils establish an equilibrium. Soils with higher phosphorus will leach more phosphorus into soil pore water than soils with lower phosphorus. This can result in significant phosphorus leaching from soils and is yet another way in that an activity that occurred years ago can affect water quality today.

Recent research has also shown that area groundwater has significant phosphorus concentrations. All of the streams in the watershed have body of groundwater associated with them, referred to as alluvium, which supplies their makes up the portion of their flow referred to as "base flow". Nutrient concentrations in these alluvial deposits are elevated. However, it is not well known how long it took for these deposits to accumulate high nutrient concentrations and it is not well known how long it will take for these systems to flush themselves of nutrients.

10. Based upon my review of the information available, it is clear that the past application of poultry waste to soils in the watershed has contributed to the historical water quality problems in the watershed. Moreover, these historical applications are also contributing to the current and ongoing degradation in these systems. Phosphorus concentrations have been significantly elevated above background levels in the Illinois River since at least the 1970s. It is also apparent that nonpoint source pollution has always been a significant contributor of this phosphorus and that pastureland as one of the major land uses in the watershed, is a significant contributor to this nonpoint source load. Historical data also suggests that while nutrient concentrations in the Illinois River have long been elevated in the Arkansas portion of the watershed, concentrations historically decreased moving downstream from near the Stateline above the confluence with Tahlequah Creek, indicating fewer sources of nutrients existed in Oklahoma than in Arkansas. Today, however, no such decrease in concentration is evident in the water quality data, suggesting that loading from the Oklahoma portion of the watershed has increased over time. The water quality conditions that are currently reflected in the Illinois River and Lake Tenkiller have their roots in gradual changes that have been taking place in the watershed over the latter half of the twentieth century and to address only activities that have occurred within the last five years would fail to address the activities that have led to degradation of the water quality. Furthermore, the phosphorus affecting water quality problems in the river today may have been land applied two weeks ago or twenty years ago.

FURTHER AFFIANT SAYETH NOT.

Shanon J. Phillips

Subscribed and sworn to me by on the 19th day of December, 2007.

Signature

Ann Craven

Printed Name

Notary Public, Oklahoma County, Oklahoma

My Commission Expires: 04/25/10